

TITLE PAGE

Web-based searching for abortion information during health emergencies: a case study of Brazil during the 2015/16 Zika outbreak.

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Abstract

Sexual and reproductive health needs and access are often neglected during health emergencies. The 2015/16 Zika epidemic is an example of priorities shifting to the detriment of women's health needs. The internet is a key tool for abortion knowledge sharing and seeking in countries where abortion is not legally available and it is also a key resource for tele-health. Yet, we know very little about how people use the internet, and the type of information searched for, to access abortion information and services. The aim of this study is to analyse to what extent and how the internet was used as a resource for abortion information during the Zika outbreak and its aftermath in Brazil in 2015/16. Using Google Trends and Analytics data, we analyse contextually-specific abortion searches using standardised terms that reflect the overall representation of searches at that time alongside weekly levels of Zika incidence. The results show a heightened use of combined search terms for abortion and Zika, as well as abortion and microcephaly, suggesting a rise in abortion information searching linked to the epidemic. These searches were highly correlated with the level of Zika incidence. This study confirms the use of the internet for information seeking during a public health emergency. It demonstrates the need for appropriate internet resources to improve access to abortion information, especially in countries where abortion is highly restricted and stigmatised.

Keywords: abortion, Google Trends, Zika, microcephaly, tele-health, internet

Background

Health emergencies, including Ebola, Zika and COVID-19, are characterised by neglect of gendered differences in experiences of, and responses to, infectious disease outbreaks. Sexual and reproductive health (SRH) has been highlighted as a critical health issue that has been ignored during health emergencies. (Smith 2019) This neglect has multiple sources: shifts of resources (human and financial) to focus on the health emergency; disruptions to commodity supply chains; and deliberate moves to erode existing rights at a time when

attention is focused on the emergency and the provision of essential services. Such trends have been evident in all recent health emergencies: Zika in Latin America (Aiken, Scott et al. 2016, Goldthwaite and Velasquez 2016, Roa 2016, Wenham, Arevalo et al. 2019), Ebola in Sub-Saharan Africa (Delamou, Hammonds et al. 2014, Menéndez, Lucas et al. 2015) and COVID-19 worldwide. (Hall, Samari et al. 2020, Hussein 2020, Wenham, Smith et al. 2020)

Previous research has highlighted the need for the response to infectious disease outbreaks to include SRH as a key component to make sure women's health and rights are protected. (Wenham, Arevalo et al. 2019) A critical component of SRH in health emergencies is access to abortion, and abortion-related information and services, but we know little about how people navigate to find information about abortion during health emergencies when there is a double "tyranny of the urgent", for both unwanted pregnancies and the health emergency. (Smith 2019)

The knowledge environment is a critical component of trajectories to abortion-related care and includes both generalised discourses around abortion and the specific information that an individual might (not) know or seek. (Coast, Norris et al. 2018) The content and quality of information provided or found can be correct or incorrect, directive or non-directive, relate to a range of issues (safety, availability, legality, cost), come from a range of sources (national or international) and use different technologies and media. Although the impact of internet access on abortion-seeking behaviours is unclear, previous evidence from the USA has shown that accessing the internet for abortion-related information is directly related to the level of legal restrictions on it. (Reis and Brownstein 2010) Where restrictions are higher, a higher volume of internet searches for abortion-related terms is found. A need to seek information secretly because of abortion stigma and/or illegality adds additional barriers to information and care-seeking for abortion. (Rossier 2007, Nandagiri 2019)

Reflecting increasing global internet access, the use of the internet to search for information on abortion, especially in contexts where abortion is legally restricted, is growing. (Reis and Brownstein 2010) Tele-health, e-health and telemedicine (the use of the internet and/or phone services) to support medical abortion (the use of mifepristone and misoprostol to terminate pregnancy) are a key feature of the abortion access landscape and can provide access to information and care in a range of legal settings. (Gomperts, Jelinska et al. 2008, Gomperts, van der Vleuten et al. 2014) Tele-health is one strategy deployed as a response to a health emergency, such as in the UK during COVID-19. (Ghallagher 2020) Immediately after the declaration of the Zika epidemic as a Public Health Emergency of International Concern (PHEIC), requests for services from Women on Web, a tele-health platform which provides medical abortion in restricted settings, increased in Brazil by between 36% and 108%. (Aiken, Scott et al. 2016) Demand for existing e-health information and services may also increase in routine times of non-crisis. (Nanda, Lebetkin et al. 2020)

In addition, there has been a growing presence on the web of feminist and reproductive rights groups who have exploited digital media to get messages across. Little is known, however, about how people search for abortion-related information online: what sort of language is used, and how the content and volume of searches change during health emergencies. Most of the evidence to date is based on data from tele-health organisations; these data are organisation-specific and reflect the market capture of a subset of people.

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An analysis of the background of Brazilian women accessing the services of the Women on Web website showed that almost half of the people contacting the service are poor and of younger age (below 25 years old), (Larrea, Palència et al. 2015) while women with internet access are usually more educated and wealthier compared to the general population.

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In this paper we investigate if and how the internet was used for seeking abortion information during the 2015/16 Zika health emergency in Brazil. The Zika epidemic in Latin America emerged in 2015 and the birth of children with Congenital Zika Syndrome (including microcephaly), brought to the fore discussions about reproductive rights during health emergencies, as women became fearful about their current or future pregnancies. (Goldthwaite and Velasquez 2016) We analysed two sets of internet-based data. First, we analysed Google Trends (GT) data related to abortion key words, before, during and after the Zika crisis, to explore whether Zika had an impact on web-based searches. We then analysed the volume of traffic from Brazil to a tele-health provider -Women Help Women, using Google Analytics (GA).

This study contributes evidence about how people search for abortion-related information during health emergencies. (Coast, Norris et al. 2018) Analysing behaviours through the lens of internet interest sheds light on the type of information needed at the time of a health crisis.

The information we have compiled for this study is of interest both for the impact that Zika had on abortion information-seeking, and also to improve information available to people seeking to terminate a pregnancy and to understand any changes in demand for abortion during health emergencies.

Context

Brazil was the country most affected by the Zika outbreak, and has one of the most restrictive abortion legislations in Latin America, permitting termination to save a woman's life, in cases of rape and incest or if a foetus has anencephaly (where it develops without a brain). (Carvalho de Souza 2011) Calls for abortion decriminalisation were sparked off in the 1980s in the early days of democratisation and increased until 2005, when a full abortion law reform, tabled by the Executive Branch, was impeded by the first corruption crisis of the Worker's Party (PT) government. (De Assis Machado and Maciel 2017) Since then, the struggle for abortion rights has, by and large, lost ground, except for a few key moments.

In 2012, the Supreme Court granted the right to abortion in the case of anencephaly. (Ray 2012) Then, in late 2014, after two women died of botched illegal abortions in Rio, the

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problem of unsafe abortions once again reached the press and feminists expressed their repudiation. A year later, in October and November 2015, feminists took to the streets to protest against imminent threats to the legality of abortion in the case of rape. These demonstrations coincided with the eruption of the Zika crisis in relation to pregnancy. The sequence of events reactivated the public debate on abortion rights, leading to a Senate debate on legalisation and the tabling of two lawsuits at the Supreme Court. The first debate, presented in 2016, called for the social and individual rights of women affected by Zika and was dismissed in 2020. The second, presented in March 2017, called for the legalisation of abortion upon demand until the 13th week of pregnancy. A decision is still pending. (Machado and Cook 2018)

In Brazil, access to the internet within households is high, but unequal across the country, reflecting socio-economic development inequalities across regions (Table 1). The south and centre-west states are the most economically prosperous and include states such as São Paulo, Rio de Janeiro and Minas Gerais. These states have higher access to the internet while the northeast states, a region which includes states such as Bahia and Pernambuco, have the lowest indicators.

In countries like Brazil where the use of social media is historically high and access to abortion is limited, the search for information on pregnancy termination and medical abortion has expanded geometrically in the last two decades. This continued even when, in 2006, severe restrictions were imposed on internet advertising on abortion by ANVISA (Agência Nacional de Vigilância Sanitária), the national regulatory health agency (Ferreira 2015). Access to medical abortion through tele-health in Brazil has been previously researched. (Larrea, Palència et al. 2015). Despite the legal restrictions of abortion, telemedicine was accessible for several years until the Government restricted access to misoprostol by attempting to control the flow of information about misoprostol on the internet (Gomperts, van der Vleuten et al. 2014)

The Zika epidemic showed worsening trends in May 2015, with a clear peak in February 2016, progressively slowing down by September 2016 (Figure 1). National-level data on Zika in Brazil obscure significant state-level variation (Table 1). The beginning of the epidemic was mostly in the northeast and north, with Pernambuco in the northeast reporting the highest percentage of suspected and confirmed cases of microcephaly, one of the symptoms later referred to as congenital Zika syndrome (CZS), with 231,725 suspected and 137,288 confirmed cases throughout Brazil). By the end of the epidemic the highest Zika incidence was reported in the southeast followed by the northeast, while the highest incidence of microcephaly was reported in the northeast.

[Table 1 here]

[Figure 1 here]

To situate and understand internet searches related to abortion during the Zika outbreak it is important to understand the timeline of events in Brazil. Zika was first reported in Brazil in May 2015 with reports from health clinics of an unknown rash and fever. (Lowe, Barcellos et al. 2018) However, it was not until later in 2015 that a higher than expected incidence of

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microcephaly began to emerge. In northeast Brazil, by November 2015, several hundred cases of microcephaly were being reported each month. (de Oliveira, de França et al. 2017) Associations began to be made between the mysterious rash in mothers and children born with microcephaly, (Neurocirurgia 2016) leading to multiple investigations and declarations of emergencies within state governance structures to facilitate emergency funding for investigations and preventive vector control. In November 2015, the Ministry of Health declared a national public health emergency and confirmed the link between Zika and microcephaly. (Saúde 2015) In the midst of the emergency the Brazilian government released a statement asking women to postpone getting pregnant, a statement which was subsequently widely criticised. (Diniz, Medeiros et al. 2017) During this period, the epidemic received wide media coverage. (Aguilar and Araujo 2016, Lima 2016) These emergency declarations facilitated greater financing for state governments in their response efforts and justified the use of the military to support community health workers and vector control agents to combat mosquitoes. (Saúde 2015) By February 2016, WHO had declared Zika and microcephaly a Public Health Emergency of International Concern. (WHO 2016) In March 2016, an article in the New England Journal of Medicine consolidated the link between microcephaly and Zika. (Rasmussen, Jamieson et al. 2016) The end of the public health emergency was declared in November 2016, and the Brazilian government ended the state of emergency on the 11th of May 2017. A series of analyses that have been conducted subsequently on the media coverage of the epidemic also showed that the peak occurred in February 2016. This coincided with the WHO's declaration of the international emergency. Media interest started gradually in November 2015, finally disappearing after May 2016. (Aguilar and Araujo 2016, Lima 2016)

Why northeast Brazil emerged as the epicentre of the CZS outbreak has yet to be fully explained, but possibilities include co-infection with dengue fever, (Estofolete, Terzian et al. 2019) increased severity of Zika infections, (Brady, Osgood-Zimmerman et al. 2019) lower access to contraceptives, leading to a higher rate of sexual transmissions, (Borges, Moreau et al. 2018) lower access to water and sanitation facilities, lower nutritional status of mothers and the lower socio-economic background of the region (meaning less access to insecticides/housing with screens, running water etc). Fake conspiracy narratives also erupted, asserting that states where modified mosquitoes, which are unable to transmit arboviruses, had been introduced as a form of vector control, showed greater increases in CZS as a result. This caused widespread panic

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As noted above, the epidemic reopened the media debate on abortion rights, with many feminist and other pro-abortion rights voices calling, once again, for liberalisation of the law. (Gressick, Gelpi et al. 2019) While it is not clear how the public reacted to these calls, the hypothesis may be raised that, under the impact of this intensified public debate, women may have felt more comfortable searching for information on, and accessing abortion pills, online. What was clear at the time, however, was that the Minister of Health had asked women to avoid pregnancy without creating a facilitative environment in which to do so –

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Fake conspiracy narratives also erupted, asserting that states where modified mosquitoes, which are unable to transmit arboviruses, had been introduced as a form of vector control, showed greater increases in CZS as a result. This caused widespread panic

i.e. one where women have autonomy to decide their reproductive futures. (Wenham, Arevalo et al. 2019) Regulatory and structural barriers remained for women seeking to access contraception, emergency contraception and abortion.

Data and methods

In this study we analysed two sources of web-based data: GT data; and GA data from a web-based tele-health provider of Medical Abortion (MA).

Google Trends

Data was accessed on the 14 April 2020. We used GT (Google 2021) weekly data between the 1st of January 2015 and the 31st of May 2017, a timeframe which spans the period before, during and after the peak of the Zika epidemic. (Depoux, Philibert et al. 2018) We did this to track trends in searches about abortion which are useful not only for their overall interest, but also to track fluctuations across time in line with other policy changes during this timeframe. We normalised the GT data by total searches, an established technique in internet studies, (Carneiro and Mylonakis 2009, Nghiem, Papworth et al. 2016, Arora, McKee et al. 2019, Google 2019) meaning that:

$$\text{search interest} = (\# \text{ of queries for keyword}) / (\text{total GT queries})$$

Thus, our abortion-specific data trends are relative to the overall number of searches at that time in that location (Google 2019). This approach accounts for individuals doing the same search more than once within a short time period (Google does not specify the length of time), so each search is only counted once. Therefore, any deviation from the overall level of searches for terms associated with abortion would be significant and might be linked to an event or to an increase in media attention.

Searches were conducted in Portuguese and English using context-specific language identified based on key informant perspectives combined with insights from social media (Twitter) identified by the authors (Supplemental data, Appendix 1).

GT search results are proportionate to the time and location of a query using a systematic process:

- Each data point is divided by the total searches of the country/region and time range it represents to compare relative popularity. If this relative popularity is not established, then locations with the largest search volume would always be ranked highest.
- The resulting numbers are then scaled on a range of 0 to 100 based on a topic's proportion to all searches on all topics.

GT only shows data for popular terms and search terms with low volume appear as "0". If over the period analysed there are not enough searches to create a trend, GT would not produce any data. The analyses exclude queries with special characters (eg: apostrophes) because these are filtered out by GT. Different regions that show the same search interest for a term do not always have the same total search volumes.

There are established approaches to correct for shifting baselines in overall internet search volume. We scaled relative monthly search volume for each keyword by dividing it by a benchmark term. We selected benchmark terms - *software, computer, life, love* - based on established approaches. (Nghiem, Papworth et al. 2016) The four benchmark terms were selected to represent a range of higher / lower relevance for the focus of our study - abortion - to assess the sensitivity of this correction to the choice of benchmark term. Prior research has established that these four terms are constant in popularity and unaffected by changing volumes of internet searches. We checked the trend over the period and confirmed them to be constant. For presentation, we only show the results relative to one benchmark term (love); results for the other three benchmark terms were similar. Our use of this approach allows us to account for the fact that our analyses can only consider search frequency, and not the final landing webpage of the search.

Finally, we considered comparisons across states; we added this intra-national analysis to explore whether there was any relationship between internet searches and Zika incidence, which varied geographically within Brazil. GT reports in which location the search term was most popular during the set time frame. The results are relative with values on a scale from 0 to 100, where 100 is the location with the most popularity as a fraction of total searches in that location (Google 2021). The results are a relative measure of the popularity of a term, not absolute, and are not weighted by size of the state.

We conducted two sets of GT analyses. First, we applied Mann-Kendall tests to detect any trends over time. (Yue, Pilon et al. 2002) This non-parametric test is usually used for time series data which are not normally distributed. Mann-Kendall tests the hypothesis that the data has no trend by producing a coefficient - *tau* - which observes the trends of each of the search terms we considered across time. Second, we looked at correlations between the key search terms to understand whether there is a common trend between them, for example, searches on abortion and Zika. For this we used the Spearman *rho* test which is a test between two non-normally distributed trends. (Yue, Pilon et al. 2002, Öñöz and Bayazit 2003, Nghiem, Papworth et al. 2016)

Google Analytics

We analysed the GA data for the tele-health medical abortion provider Women Help Women. We focused on one tele-health provider only as it has a large market capture in Brazil, and we have pre-established relationships and so were able to access their data. GA is also being used as a comparative narrative to GT which is the main focus of our analysis. Other studies have already analysed GA data on another large provider, Women on Web. (Aiken, Scott et al. 2016) GA is usually used as a marketing tool to track the traffic on website pages. Analytics measures the number of “clicks” that land on website pages during the same period we observed for GT. (Plaza 2009) Information can be retrieved by date, place of location of the search, time spent on the page, whether the individual typed the page address directly or arrives through other websites (e.g. Google) and internet service provider. It can tell us how many visits a day a specific page had and how long on average users stayed on the page as well as repeated visits. Overall, the analysis of GA for an e-health website can give us an idea of trends in interest in medical abortion over a time period. We looked at the number of visits on the main Women Help Women website for the

period 1 January – 31 May 2017. For the analysis of these data we used the same statistical tools used for GT data. We calculated the monotony of the trend data with the Mann-Kendal τ and the Spearman ρ to test the correlation of the trend with Zika incidence levels. No ethical clearance was sought as we analysed secondary anonymised data.

Limitations *[Should limitations go after Results?]*

The limitations of our data and analyses are common to research that uses internet search data. First, there are substantial inter- and intra-country variations in internet availability, accessibility and use. Second, we do not know anything about the characteristics of the person conducting the search. In every setting, individuals with greater resources (education, financial, computer/phone ownership etc.) have lower barriers to accessing internet-based information. (Arora, McKee et al. 2019) There are limitations to the GT algorithm because it relies on the relative traffic of search during the period. Therefore, if a popular topic accounts for more searches during the same period, GT is unable to capture significant changes in patterns. Finally, it would have been analytically insightful to compare search term trends with microcephaly incidence data as well. Consistent and reliable weekly data on microcephaly were not available; consistent weekly data were only available for Zika incidence. But we consider Zika values to represent an accurate picture of the intensity of the emergency and possibly *of greater resonance* at the time. In addition, an analysis of the incomplete microcephaly data showed a high level of correlation with Zika epidemiological trends.

GA data has many similar shortcomings to GT, including not being able to know the individual's characteristics and importantly, what they do with the information obtained from the website. In addition, it is often not possible to get the level of regional detail (we only get state level of information) necessary to have an in-depth analysis of the location of the searches.

Results

We present the results of the Portuguese searches only as the English searches either did not produce enough data to display or did not report any significant trend. We show only trends where data were available and report the most significant trends (e.g. there were enough data and the trend showed a meaningful pattern). The trends show a clear prominence of searches including the word Zika (Figure 2) around the time of the peak of the epidemic (Nov 2015-April 2016). This is *probably reflection* in increased media attention *after* the Brazilian government and the WHO declarations of a public health emergency. The peak of the searches also clearly matches the peak of the epidemic (Figure 1).

The relative volume of searches that only included the word *aborto (abortion)* is consistently low across the same time period. However, a clear increase is seen around the time (Nov/Dec 2016) of a national debate about the legal status of abortion in Brazil when the Brazilian Supreme Court issued an opinion on legalisation of abortion when judging a criminal case under which several abortion providers were arrested. (Freitas and Grotz 2016, Gressick, Gelpi et al. 2019)

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On its own, searches related to the word **aborto** show no relationship with the Zika health emergency and there are no trends for searches related to medical abortion (misoprostol) or abortion pills (**comprimido, misoprostol, pastilha or medicamento**). Abortion and legalisation words together showed a spike again in the summer of 2016 at the time of the Supreme Court opinion on abortion legalisation.

[Figure 2 here]

What is noticeable is the increase in searches that combine **aborto** and Zika during the peak of the Zika outbreak in Brazil. Those who were searching for abortion-related information were clearly looking in conjunction with Zika.

Regional variations in search term volume and trends are mixed (Supplemental data, Table A1). More economically developed states (e.g. Rio de Janeiro, Minas Gerais) show higher volumes of searches. Zika, abortion and microcephaly (*microcefalia*) seem to **reflect** interest in all the Brazilian states in terms of popular searches. However, the combinations of search terms (e.g.: *Zika+aborto* or *aborto+microcefalia*) are popular only in a smaller number of states and often do not report enough data to show any values for those terms. During the period of observation, the two regions in Brazil with the highest searches on Zika and abortion (*Zika+aborto*) together were the State of Alagoas and the state of Rio de Janeiro, followed by the state of Bahia. While Rio de Janeiro and Bahia were the states with high incidence of Zika in the country during the study period, they were not states with a high prevalence of either Zika and/or microcephaly

The analysis of the GA data from the tele-health abortion provider Women Help Women (WHW) showed a different trend altogether. With these data we wanted to understand whether the epidemic sparked a rise in seeking medical abortion services. The data for WHW showed an increase in interest during this period (landings on the WHW page more than tripled between January 2015 and December 2016). However, this interest continued to rise until the end of the observation period, showing no real link with the epidemic (e.g.: there was no decline after the end of the peak period). The *tau* value of the trend is significantly positive (*tau*=0.640, $p<0.001$) but the correlation with the Zika incidence is not significant.

Trend analysis

Only one of our search terms (*aborto+comprimido*) showed a monotonic trend (Table 2), meaning that where increases in search term volume occurred, they were temporary. This set of analyses gave us a general check that the level of interest was therefore confined to the epidemic and not to a general trend. Zika, as expected, was increasing as well as the combined *aborto+Zika* search. Although weak (-0.046), the trend of the term *aborto* seemed to be declining over the period. More interestingly, *aborto+comprimido* was significantly increasing over this period (0.085, $0.001<p<0.05$) showing a possible increase in interest on medical abortion. However, the same was not true for the trends of the search of the word misoprostol which could be as likely to be used for medical abortion as *comprimido*. The *tau* value for the period was 0.639 ($p<0.000$), showing a significantly strong increasing trend in line with the analysis of the data we reported in the previous section.

[Table 2 here]

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Where the correlation between the search terms is significant (Table 3) it means that the terms were either increasing in popularity (positive) at the same time or that they were diverging in popularity (negative). Searches for combined *Zika+aborto* terms are positively correlated with both the searches of the terms *aborto* (0.286, $p<0.001$) and *Zika* (0.575, $p<0.001$). While *Zika* and abortion are not correlated, the terms *microcefalia+aborto* are correlated, perhaps showing increased concern for a potential outcome of the disease rather than the disease itself. Search terms about legal or legalisation (e.g.: *aborto+legal*) were not significantly associated with either trends or other search terms at the time.

The incidence shows a strong correlation with the terms *Zika* and microcephaly, as expected, but also with the combination abortion and microcephaly and *Zika* (0.434, $p<0.001$). Misoprostol is positively correlated with the search microcephaly (0.246, $0.01<p<0.05$) and abortion+microcephaly (0.226, $0.01<p<0.05$).

No significant correlation was reported between the WHW GA data and the *Zika* incidence trends.

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Discussion and Conclusions

This study has shown clearly that people were searching online for information about abortion in connection with *Zika* and/or microcephaly over the *Zika* health emergency period. Most notably the study highlighted discrepancies between the searches and the epidemic across states. This could be because of state-level differences and, in particular, between the northeast and south of the country, (Lima 2016, Lowe, Barcellos et al. 2018, Wenham, Arevalo et al. 2019) reflecting a combination of factors which include level of internet access, perception of risk of microcephaly and other differences across the states consistent with other studies. (Reis and Brownstein 2010). Overall, there is a mismatch of gravity of the epidemic and surge of internet search at state level. Most likely this is due to availability of access to internet, educational levels and awareness of availability of services/information online. This is in contrast with previous research in the USA that showed an inverse relation between access to internet for abortion services and level of legalisation within the state. (Reis and Brownstein 2010)

Tele-health and medical abortion also increased during the time of the epidemic, beyond what could be considered routine service provider growth. First, the rise could reflect the increase in visibility of WHW on the web (they were set up in 2014 just before the epidemic started). Second, when comparing with the results by Aiken et al., Women on Web conducted a specific campaign on *Zika* and abortion in Brazil at a time when their presence was already strong. (Larrea, Palència et al. 2015, Aiken, Scott et al. 2016) In addition, the increase in debate on the legalisation of abortion could have increased individuals' knowledge of the availability of medical abortion services through the internet. (Aiken, Scott et al. 2016, Gressick, Gelpi et al. 2019). Finally, the comparison would not be strictly appropriate as Aiken et al used actual consultations in their study rather than GA, confined to a very limited period which included the peak of the epidemic only. (Aiken, Scott et al. 2016) Using these data, we are unable to investigate whether the search trends are as a

direct consequence of the epidemic or driven by the wider debate on abortion legislation. (Gressick, Gelpi et al. 2019) We believe the findings demonstrate increasing awareness of these services in Brazil as a consequence of Zika. Nevertheless, we could speculate that given the increase in access to search words linking abortion and Zika, the epidemic was implicated in the upward trend in accessing e-health services, although we have no data on abortions to validate this.

In this study we can only make inferences about the reasons behind the trends. It could be that usually this kind of information is only available to more educated, wealthier individuals. We are also unable to account for how information is otherwise disseminated, such as through informal networks or social media groups such as on Facebook. More generally we lack information on the diffusion of information through informal networks, including word of mouth and gossip. (Coast, Norris et al. 2018)

Despite the data limitations, the analysis shows a clear need to investigate further the type of information individuals access at a time of health emergency, and how this affects their trajectory towards abortion (or not). This is particularly important in settings where information is restricted and access to services difficult.

Our analyses are the first to analyse GT data alongside the incidence of an epidemic and demonstrate the value of doing so. At the time of a heightened crisis because of an epidemic such as Zika or the current COVID-19 crisis, there needs to be a greater effort to provide quality information about how to access SRH services during changes to regular provision or the introduction of non-pharmaceutical interventions, such as lockdown. Very recent literature has highlighted how SRH issues get neglected **at a time of pandemics and more in general at times of public health crises**. (Hall, Samari et al. 2020, Hussein 2020, Wenham, Smith et al. 2020). Prioritisation of COVID-19 interventions, for example, have come to the detriment of many other health services, with SRH and abortion services being among the most affected. Public health campaigns during a health emergency should include information on access to SRH services, which in turn should be ringfenced in resource reallocation. In a legally restricted setting, information on access to safe abortion must use effective channels. This study has demonstrated that the internet is one of those channels and we need to make sure that the information available is correct and accessible. Importantly, despite the current focus on COVID-19, Zika continues to circulate in Brazil. Indeed, the distortion of the health system for COVID-19 related care has led to a reduction of vector control, and thus we expect increased rates of arbovirus in the coming year(s). (Olive, Baldet et al. 2020) Future studies will need to examine fine-grained data to understand what kind of pathways individuals travel to access internet information about abortion. We need to better understand people's informational needs, and their capabilities to meet those needs. Without such understanding, information and services cannot be designed to meet people's needs, not only during health emergencies, but more generally.

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Commented [A15]: I'm not sure of your meaning

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Table 1 Background data Brazil 2015-16

	Households using the Internet (% of population) 2016 ⁱ	GRP per capita in USD ⁱⁱ	Microcephaly ⁱⁱⁱ Total number of cases Jan 2015/Nov 2016	Zika cases in 2016 (/100,000 inhabitants) ^{iv}	Abortion rate (per 1000 women aged 15-49)	Abortion legal status ^v
Total	69.4	8,727	1950	105.3	32	Allowed to save woman's life and in case of rape
North	62.4	5,430	71	74.2		
North-East	56.5	4,495	1487	134.4		
South East	76.7	11,294	270	106.2		
South	71.3	10,379	23	3.4		
Centre-West	74.6	11,119	88	222		

i. <https://www.ibge.gov.br/estatisticas/multidominio/ciencia-tecnologia-e-inovacao/17270-pnad-continua.html?=&t=resultados>

ii. Source: <https://agenciadenoticias.ibge.gov.br/agencia-sala-de-imprensa/2013-agencia-de-noticias/releases/23038-contas-regionais-2016-entre-as-27-unidades-da-federacao-somente-roraima-teve-crescimento-do-pib>

iii. [https://www.thelancet.com/journals/lancet/article/PIIS0140-6736\(17\)31368-5/fulltext](https://www.thelancet.com/journals/lancet/article/PIIS0140-6736(17)31368-5/fulltext)

iv. https://www.saude.gov.br/images/pdf/2017/fevereiro/05/2017_002-Dengue%20SE52_corrigido.pdf

v. <https://reproductiverights.org/worldabortionlaws> accessed 14/04/2020

Table 2 Mann-Kendall trend test *tau* values for GT trends

Search term	Brazil
Abortion	-0.046
Zika	0.058
Misoprostol	-0.097
Abortion+Zika	0.030
Abortion+pill	0.085**
Microcephaly	0.010
Abortion+Microcephaly	0.030
Abortion+misoprostol	-0.021

Significance: **p<0.05

The *tau* value should be interpreted as a correlation coefficient between -1 and +1. A negative number shows a decline over time. A positive number shows an increase over time.

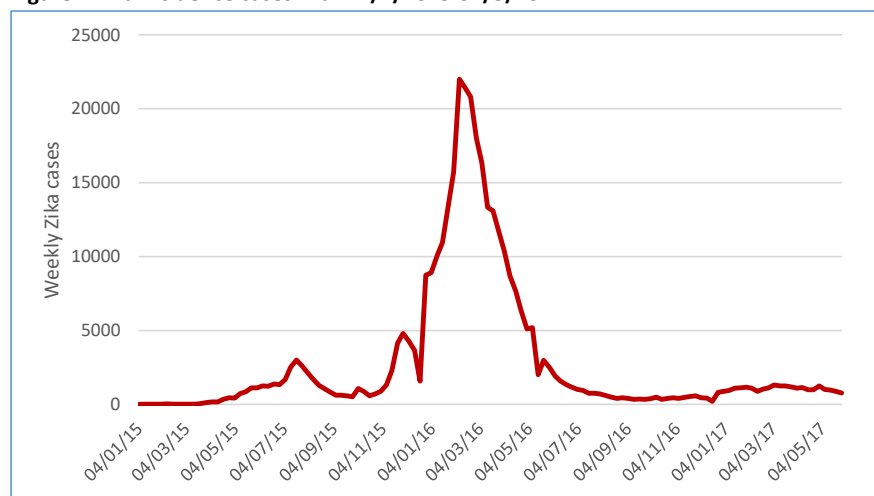
Table 3 Correlation terms Spearman *rho* correlation, GT search terms and Zika incidence Brazil 1/1/15-31/5/17

	Zika	Abortion	Microcephaly	Misoprostol	Abortion +Zika	Abortion+ Microcephaly	Abortion +pill	Zika Incidence
Zika	1							
Abortion	0.0218	1						
Microcephaly	0.696***	0.323***	1					
Misoprostol	0.053	0.091	0.246**	1				
Abortion +zika	0.282***	0.067	0.287***	0.187	1			
Abortion+ Microcephaly	0.708***	0.249*	0.755	0.226*	0.437***	1		
Abortion+pill	0.029	0.305**	0.115	-0.171	-0.138	0.069	1	
Zika incidence	0.822***	-0.117	0.517*	-0.069	0.054	0.434*	-0.002	1

*** p<0.001, ** 0.005<p<0.001

- *p>0.10

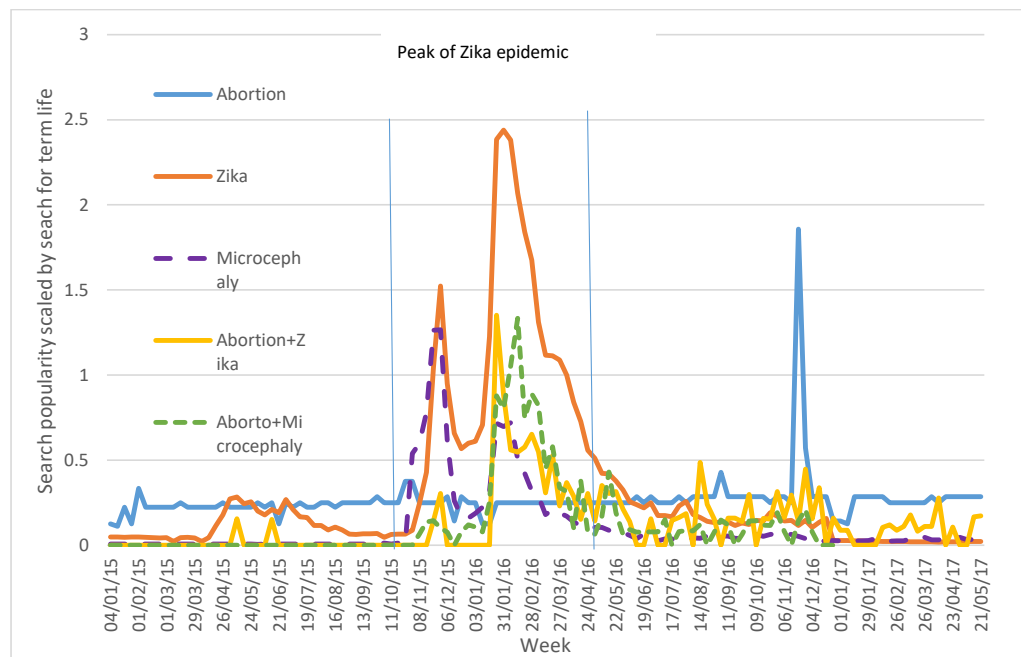
Figure 1 Zika incidence cases Brazil 1/1/2015-31/5/2017



Source: PAHO weekly data <https://www.paho.org/data/index.php/en/mnu-topics/zika/524-zika-weekly-en.html>

Figure 2 Google Trends selected search terms Brazil 1/1/15-31/5/17





Appendix

List of search terms used in Portuguese and English

- Aborto
- Aborto+internet
- Aborto+postar
- Aborto+enviar
- Aborto+zika
- Abortio+pastilha
- Aborto+comprimido
- Aborto+pilula
- Aborto+legal
- Aborto+legal+zika
- Aborto+medico
- Aborto+Microcefalia
- Aborto+Misoprostol
- Abortion
- Abortion+legal
- Abortion+legal+Zika
- Abortion+medical
- Abortion+Microcephaly
- Abortion+post
- Abortion+mail
- Abortion+internet
- interrupção da gravidez
- interrupção da gravidez+Zika
- Interruption of pregnancy
- Interruption of pregnancy+Zika
- Microfacelia
- Microcephaly
- Microfacelia+aborto
- Microcephaly+abortion
- Misoprostol
- Misoprostol+Zika
- Zika

Table A1 regional “popularity” on GT by search term and by state in Brazil, 1/1/15-31/05/2017

State	Zika	Abortion	Microcephaly	Abortion+ Zika	Abortion+ microcephaly	Misoprostol
North						
Acre	49	80	42			98
Amazonas	65	77	45			100
Amapa	52	100	37			83
Pará	33	56	33	11		70
Roraima	66	76	62			
Rondonia	47	67	43			76
Tocantins	72	73	57			96
North East						
Alagoas	100	64	78			49
Bahia	75	79	72	59		71
Ceara	62	72	62	40		76
Maranhao	74	73	71			75
Paraiba	66	64	79	100		68
Pernambuco	56	70	100	28		64
Piauí	44	80	69			93
Rio Grande do Norte	55	64	76			54
Sergipe	51	65	68			65
SouthEast						
Espirito Santo	49	59	45	27		64
Minas Gerais	54	66	47	56	100	75
Rio de Janeiro	76	66	44	44	58	72
São Paulo	40	59	39	30	58	61
South						
Paraná	63	74	43			65
Rio Grande do Sul	31	56	31	32		73
Santa Catarina	31	51	33	25		67
Central West						
Federal District	48	65	50	39		78
Goias	52	70	48	37		80
Mato Grosso	75	64	57	99		58
Mato Grosso do Sul	52	63	43			83

Note: relative volume of searches standardised at state level.